Modified microporous polypropylene flat sheet membrane via TIPS for membrane distillation

WANG Yujie[a,b]*, ZHAO Zhi ping[b], LUAN Jinyi[a], XI Zhenyu[a], YANG Yongqiang[a]

a,Environmental Protection Research Institute, BRICI, SINOPEC, Beijing, 100013，CHINA.

b,Beijing Institute Technology, Chemical Engineering & Environment, Beijing, 100081，CHINA.

* correspondence,wangyuj.bjhy@sinopec.com

It has become more and more important to replace toxic solvents using greener alternatives during the membrane production process. In this work, environmental friendly binary diluents composed of Carnauba wax as latent solvent were employed for dissolving polypropylene to form homogenous solution and prepare microporous polypropylene flat sheet membrane via thermally induced phase separation process (TIPS).

The effect of binary diluents on polypropylene membrane structures and performances was investigated. The phase diagram of the PP/binary diluents system as a function of polymer weight fraction, and the phase diagram as a function of Carnauba wax fraction in the binary diluents were investigated as well. We also tried to figure out how the existence of a latent diluent influenced the mechanical properties, pore size distribution. In order to evaluate the practical aspects of latent diluent, analytical techniques were used including: scanning electron microscopy (SEM) for investigating morphology across the membrane and differential scanning calorimetry (DSC) to investigate the crystallization behavior of polymer and diluents.

It was found that the morphology of the membranes was strongly affected by binary diluents. Indeed, physicochemical characteristics of diluents influenced the interactions between binary diluents and polypropylene. Finally, the interconnected spongy structure inside microporous membrane was achieved successfully, the mechanical properties, mean pore size and pore size distribution were further controlled as well.

In the desalination test of vacuum membrane distillation, the water permeability

changed widely depending on different binary diluents, however, the salt rejection remained almost more than 99.0%.
Key words: polypropylene flat sheet membrane; thermally induced phase separation; membrane distillation, green solvent